

The Precision Halalization and Digitalization of Halal Materials and Products

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Abstract: The complexity of food nowadays makes the Halal status of food are uncertain for Muslim consumers. Some food ingredients which are not permissible in Islam might be unintentionally added by food producers. This circumstance makes Halal Certification and Halal Assurance become crucial. The Central Islamic Council of Thailand (CICOT), The Halal Standard Institute of Thailand (HSIT) and The Halal Science Center Chulalongkorn University (HSC) are working together to qualify the Thai Halal certified products to be high standard quality and trustworthy under the concept “Religion Certifies, Halal Science Supports” and National Strategy guideline “Thailand Diamond Halal”. The Precision Halalization system provides cost effective of Halal supply chain, Halal traceability, Halal safety and Halal assurance. This system includes Systematic Thai Halal Certification, Halal Forensic Science Laboratory Services, Halal Management System (HAL-Q), ID of Query Raw materials for Assuring Halalness (IQRAH) and the digitalization system called System Protocol for Halal Electronic Resource Exchange (SPHERE) which has recently initiated will facilitate the consumers and food producers to access the Halal Big Data more easily. By implementation of this system, Thailand can possibly achieve the goal to be not only kitchen to the world but Halal for all.

1 INTRODUCTION

In Shariah law, food is necessary for maintaining the human life and it is considered as one form of Ibadah. The definition of food by the term of Shariah is Halal and Tayyib while that food which is loathsome and despicable is Haram. Halal means permissible whereas Haram means forbidden (Mufti Shoaib Alam, 2017). All food is Halal only the small amount of food is Haram. The food which mainly prohibited are swine, blood, carrion, non-Islamic slaughtered animals as well as beverages containing alcohol (Demirci et al., 2016; Riaz and Chaudry, 2004). Therefore, most of the Muslims are very particular when it comes to food. They will choose to consume the food in accordance to Islamic guideline and prevent the one which is considered Haram. This concept is also applied to the Muslim minority in Thailand. This is where the Halal certification is introduced to create the consumer’s trust. At first the Thai food product is Halal certified to ensure the

Halal assurance for the Thai Muslim communities since most of the population in Thailand is non-Muslim as such the food available in the local market are possibly in contact or contaminated with Haram food. Later, Thai food product is Halal certified for the purpose of exporting of food products to Muslim consumer worldwide. Since the Muslims population is now increased to be 1,700 million and it is expected to be 2,800 million in 2050. Thus, the demand of Halal products will be continuously increased and the global Halal market will exponentially increase. Thailand as one of the world’s largest producers and exporters of food and also known to be a food basket of Asia will also take a part in this sector. The data from National Food Institute revealed that Thailand, in 2015, exports food estimated THB 897 billion (USD 25.5 billion). The main food exports are rice (17.1%), sugar (8.6%), chicken (7.8%), tuna (7.5%), and shrimp (6.3%) which occupies for 50% of all food exports. In addition, the growth rate of food exported is increased to be 9.5% during the first

quarter of 2016 which valued for THB 239 million (USD 6.8 million). Thai government believed that Thailand has potential to develop of this sector to be the “Kitchen of the World” and to achieve that Thailand have come up with the five year strategic plan to push up Thailand as a one of top five exporters of Halal products and services in the world under the branding “Thailand Diamond Halal” (Thailand Board of Investment, 2016). One of the strategies is to encourage the food manufacturers to apply Halal certification but to achieve the Halal global standard level; the Halal certification alone is not enough.

In the past, the food is simply processed, so what is Halal or Haram can be easily distinguished by referring back to the list in the Shariah book. Currently, the food is undergone numerous processes to make food more attractive, tasty as well as preservative so many food interventions lead to the complexity of food which are difficult to trace back the source of origin and the Halal status of the food could not be just simply judged according to the Shariah book. This is why science and technology should be incorporated in the Halal value chain process in order to ensure the Halal safety, Halal assurance and traceability of Halal materials with elimination of unnecessary cost in the Halal food process. The aim of this paper is to show the impact of science and technology in precision Halalization to strengthen Thailand as a non-Muslim country to be a significant player in Halal industry.

2 PRECISION HALALIZATION SYSTEMATIC HALAL CERTIFICATIONS

In Thailand, before 1949 the Halal status of food was evaluated by only the consensus of Islamic scholars. In 1971, the Halal food standard was introduced by the Islamic Committees of Thailand. Then, during 1997 the Sheikhul Islam after the approval of Islamic Committee of Thailand was appointed by His Majesty the King Rama IX to be a leader of the Islamic Affairs in Thailand. At that time, the Halal certificate was first launched and issued by Sheikhul Islam. The Sheikhul Islam also was appointed for another duty as the Chair of Islamic Committees of Thailand which was assisted by Islamic Committee of Thailand. According to Islamic Organization Act 1997, the Islamic Committee of Masjids is elected by the Muslim located in the region. The Islamic Committee of Provinces is then elected by the Islamic Committee of Masjids. The 39 Islamic Committee of Thailand is

later selected by Islamic Committee of Provinces and for 1/3 Islamic Committee of Thailand is selected by Sheikhul Islam thus all together become 52 members (Figure 1). In the process of election of the members of Islamic Organization Administration involved approximately 6 million of Muslim from all over the country. This systematic election creates the reliable Islamic committee members in the Central of Islamic Council of Thailand.

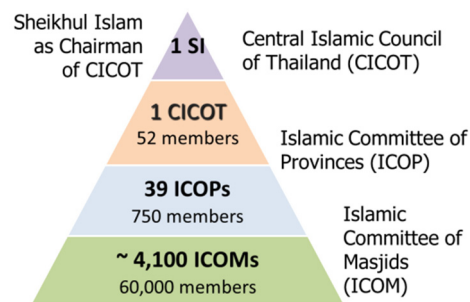


Figure 1: The hierarchy of Islamic Organization Administration of Thailand.

For Halal certification, many steps have been involved in order to obtain the Halal certificate. The food manufacturers who interested in applying Halal certification will be inspected by either the Islamic Committee of Provinces or Central Islamic Council of Thailand (CICOT). During this period, The Halal Standard Institute of Thailand and The Halal Science Center, Chulalongkorn University will give academic and scientific support to the Halal inspector. Then all the information will be sent to either the division of Halal affair of the province or the division of Halal affair of Central Islamic Council of Thailand. If the information is sent to the division of Halal affair of the province, it needs to be sent to Islamic Committee of Provinces and the Islamic Committee of Provinces will further submit the information to the division of Halal affair of Central of Islamic Council of Thailand and later on it will be directly submit to Central of Islamic Council of Thailand. Finally, the Halal certificate is being issued (Figure 2). This process is time consuming hence implementation of the digital technology is necessary to facilitate the Halal certification process which allow the user to access the system more easily. The database of the manufacturers who are applied for Halal certificate and Halal certified products are collected and uploaded into the digital system called called “System Protocol for Halal Electronic Resource Exchange (SPHERE)” which will describe in the next context.

Thus, by integrating of digital system into Thai Halal certification process, the CICOT committees, Islamic Committee of Provinces, manufacturers, consumer, and other private sectors will be able to access, exchange and check the information such as the status of Halal certificate of the product, Halal status of Halal certified product via the “SPHERE” system.

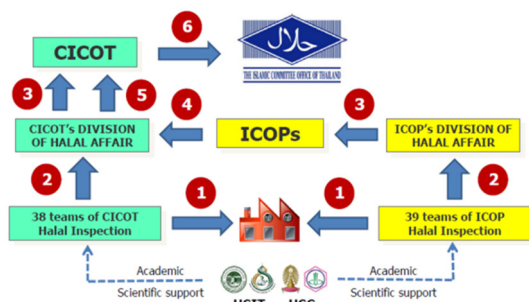


Figure 2: Halal Certification System in Thailand.

3 HALAL FORENSIC SCIENCE LABORATORY SERVICES

The advancement of modern science and technology has been used for preparing Halal food production. There are several ingredient sources which have been used in manufacturing of food products. Adulteration of haram ingredient in food product has been widespread and cannot be distinguished by simple visual inspection. Haram ingredients may be accidentally or unknowingly introduced into a food chain (Azmi, 2007; Fadzlillah *et al.*, 2011; Salahudin *et al.*, 2017). Often food producers cannot distinguish between Halal and non-Halal ingredients. This case also occurred with food producers in Thailand since most of the food producers are not Muslims. Thus, Thai Muslims which are living as minority are highly aware of the adulteration of haram ingredient in food product.

The rumors of using lard oil for coating Asian rice noodle were spread all over Thai Muslim communities. At that time (1994), Winai Dahlan as a scientist started to exploit the knowledge of science and technology to answer the issue by utilizing the facilities provided in Faculty of Allied Health Science, Chulalongkorn University. This is where the Halal Forensic Science initiated. After analyzing of the fatty acid profile of the noodle containing oil by gas chromatography, it revealed that no lard was identified in the sample. During 1997, the first pig scandal was revealed by Halal forensic science

laboratory testing. This case indicated the important of Halal forensic science in Muslim consumer protection, so later the continuation of this Halal laboratory testing plays an important role for supporting the work of CICOT to ensure the Halal status of the food product available in market. In the year 2004, The Halal Science Center was recognized and established by Thai government as The Halal Science Center, Chulalongkorn University. The Thai government continue to support from the year 2004 to the present year 2018. The Halal Science Center has been expanded from 80 m² to 4,400 m² with well-equipped scientific instruments and two more offices in ChiangMai and Pattani Provinces.

The Halal Forensic Science Laboratory is mainly focused on the detection of pork, its derivatives and alcoholic beverages as they are the main ingredients prohibited and usually added in the food processing thus, basic routine laboratory are including the analyses of porcine DNA, fatty acids profile, gelatin as well as alcohol contents. The criteria of choosing the suitable analysis methods for food product is very crucial in order to get high accuracy in lab testing. Most of the food products which containing high fat or derived from fats and oils will be tested for fatty acids profile while the food product containing more proteins will be suited to porcine DNA testing. On the other hands, most of the beverages, ketchups, flavors, coloring agents will be tested for alcohol contents since the alcohol is added as solvent in these type of products whereas the gummy and candy products will be tested for gelatin content.

In additions, some of the food sample will be tested for polar content due to health concern reason. The modern molecular approach has been developed for detection of pork and its derivative in food ingredients and food product. Animal fats, proteins and DNA are the most commonly used as the biomarkers for Halal food analysis. Fatty acids are separated by gas chromatography which the different in fatty acid profiles are depended on the sources of origins. Fatty acid is undergone the methylation reaction to form fatty acid methyl ester (FAME) and further separated by gas chromatography. Connective tissues and their derivatives are multifunctional ingredients widely used in many food and pharmaceutical industry. Gelatin is an animal by-product, the partially hydrolyzed collagen tissue of various animal parts.

The analysis of gelatin is measured by indirect determination of hydroxyproline contents. DNA can be found in a majority of animal cells and identifying the origin of food sample. Molecular techniques based on DNA analyzed are species-specific

polymerase chain reaction (PCR). PCR can be used quantitatively that can monitor the amplification of targeted DNA during the PCR process with aid of intercalating dye called real-time PCR. This method is easy to perform, high sensitivity, more specificity to detect porcine DNA contamination in food products. Besides porcine and unlawful animals, alcohol or ethanol is also in the list of Haram.

In Thailand, CICOT does not allow using liquor for producing Halal foods except in some food products containing ethanol commonly found in food manufacturing or as developed during food fermentation. For the synthetic ethanol used as the solvent for dissolving flavour or colour before adding into the food products, it will be acceptable when ethanol in the end products less than 0.5%. For the ethanol formed during the natural fermentation, it should not be excess 1.5%. Food products and beverages are analyzed by gas chromatography examined by flame ionization detector. The amount of ethanol in the food samples can be compared with calibration curve. These all laboratory testing are applied for the purpose of consumer protection in Thailand. There are 134,590 food products has been analysed during 2004-2018 by The Halal Science Center's Halal forensic laboratory (Figure 3).

However, the Halal forensic science laboratory testing is no more needed for Halal assurance, Halal traceability if both HAL-Q Halal management system and IQRAH are utilized by the food manufacturers. The details of these two approaches will be discussed in the next context.

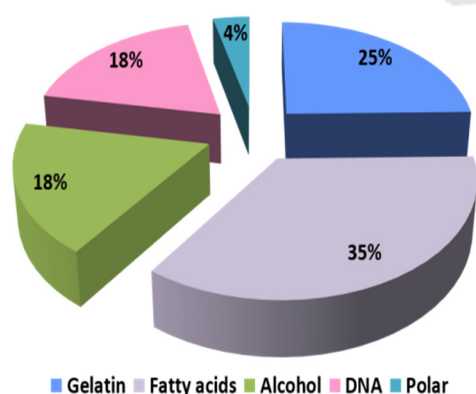


Figure 3: The percentage of 134,590 food products which have been analyzed by Halal science forensic laboratory according to laboratory testing. 25% of food products were analyzed for gelatin by indirectly measured hydroxyproline contents, 35% of food products were analysed for fatty acids profile, 18% of food products were analyzed for

alcohol content, 18% of food products were analysed for the presence of porcine DNA and 4% of food products were analysed for polar compounds.

4 HALAL MANAGEMENT SYSTEM (HAL-Q)

Many different standard quality management systems such as Global Food Safety Initiative (GFSI), International Food Standard (IFS), Safe Quality Food (SQF), as well as Hazard Analysis and Critical Control Point (HACCP) have been applied in food enterprises to get high quality products with consumer trusts. The HACCP system is considered as the most common quality management system that implemented in food enterprises worldwide.

This HACCP system is aimed to protect the consumer from potential hazards which can be termed as physical, biological and chemical hazards in food processing. However, considering the Halal food processing another hazard known as “Haram” should be eliminated from the process. Thus, another food safety management system which incorporated Halal into HACCP system has been established (Figure 4). This system is known shortly as HAL-Q (Halal, Assurance, Liability and Quality) system. It is one of Halal management systems developed (2004) by The Halal Science Center, Chulalongkorn University (HSC-CU) for Halal security assurance in HACCP-complaint enterprises in Thailand.

The concept is mainly focused on limitation or removal of the Haram ingredients from the process. This standardized Halal system (HAL-Q) is started from the food plant apply for HAL-Q need to prepare the document of the company’s profile such as the location of the company, the surrounding environment, the company procedure, process mechanism, the source of Halal ingredients, the storage, the logistics and so on. Secondly, the managers, all the staffs involved in the production line need to be in class training. This training provides the basic Halal fundamental, Halal hygiene and Halal-HACCP platform. Thirdly, the auditor will check the whole process involved in Halal food production and checkup the Haram contamination which can possibly occurred in the process. Then, set up the Haram critical control point and the QMR is appointed. All the doubtful raw materials and products will then be sent to Halal forensic science laboratory. Lastly, the auditor will examine the staff and evaluate the food plant whether the improper handling have been corrected in case the food plant get “CAR” (Corrective Action Request) from the

auditor. After scientific approving and correcting of all action, the auditor will give the HAL-Q certificate to the food plant which implies that the food plant already implemented Halal management system in their food processing and the food plant is ready for Halal accreditation by CICOT (Figure 5).

Previously, the implementation of HAL-Q management system in HACCP-compliant seafood enterprises for 5 months indicated an improvement in Halal compliance (HC) score in both two groups, Halal certified Enterprises and non-Halal certified Enterprises (Dahlan *et al.*, 2013). Surprising, some food enterprises was reported to be adulterated with pork by Halal forensic science laboratory screening. This implied that the product adulteration is sometimes derived from Halal certified food enterprises. However, the adulteration of haram ingredients tends to be reduced significantly after implementation of HAL-Q system (Katelakha *et al.*, 2014).

During the year 2004-2017, the HAL-Q system has been implemented in 717 food enterprises with 163,000 employees. After HAL-Q implementation the adulteration of haram substances could be easily monitored and eliminated. The implementation of HAL-Q is covered in all aspects of Islamic principles and recognized International standardization system if the food industry fully integrated this system in the industry, the reduction of an unnecessary cost such as laboratory testing fee could be possible. As a consequence, HAL-Q system plays an important role in Halal food industry in order to uplift the Halal certified products to be high standard quality with Halal security assurance and acceptance at international level.

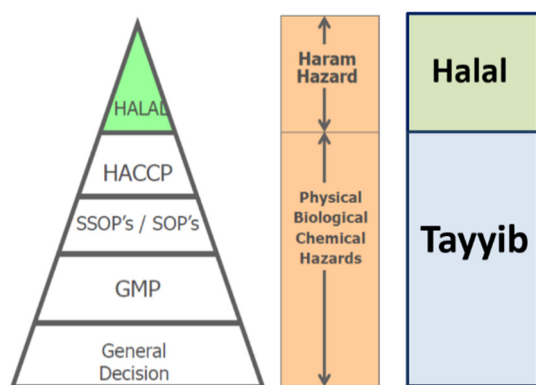


Figure 4: Halal Management System (HAL-Q) concept. The HAL-Q system is one of management system that concern not only physical, biological and chemical hazards but also Haram hazard which is the main critical control

point for managing Halal food industry. This is one of management system which top-up to the HACCP system.

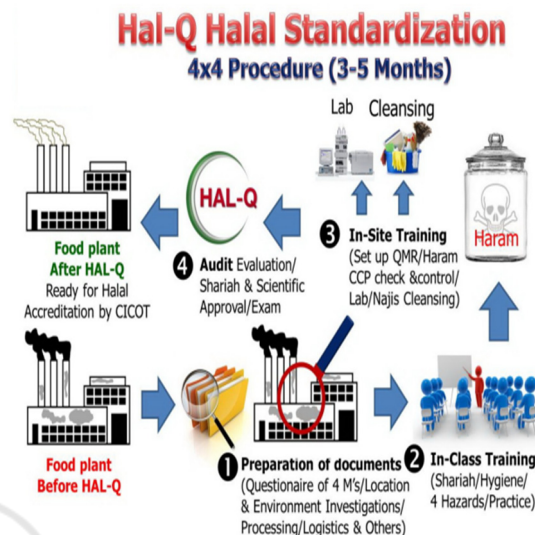


Figure 5: Steps in HAL-Q Halal Standardization.

5 ID OF QUERY RAW MATERIALS FOR ASSURING HALALNESS (IQRAH)

Food additives which are added to the food products are coded as E-numbers by EU (Codex Alimentarius Commission, 2001). All food additives need to be registered and certified by EU in order to get the E-number codes. The E-numbers are added into food production process for the purpose of preservation, inhibition of microbial activities, as well as improvement of food quality and nutritional value (Emerton and Choi, 2008). The E-numbers may act as preservative agents, antioxidant agents, emulsifiers, raising agents, and colouring agents. The E-numbers have been used and categorized (Codex Alimentarius Commission, 2001) as following:

- E100-199 - Colours
- E200-299 - Preservatives
- E300-399 - Antioxidants, Acidity regulators
- E400-499 - Thickeners, Stabilizers, Emulsifiers
- E500-599 - Salts and related compounds
- E600-699 - Flavour enhancers
- E900-999 - Surface coating agents, sweeteners
- E1000-1399 - Miscellaneous additive
- E1400-1499 - Starch derivatives

Most of the E-numbers are accepted to be used in many Muslim countries for long decades although some of the E-number is derived from non-Halal origin. The status of E-numbers is never be clarified. This is a big concern of Muslims to check the Halal status of E-numbers before deciding to use in the food production. Basically if the E-number derived from plant origin, it is considered as Halal whereas the E-number derived from animal can be considered as Halal only when it meet the criteria such as if it is derived from Islamic-slaughtered animal or the animal itself is Halal to be consumed. However, due to lack of information regarding Halal E-number, and complicated processes and chemical used in making E-numbers create the difficulties to identify the Halal status of the raw materials by Islamic scholars. This is where the Muslim scientist needs to take place to help the Islamic scholars by utilizing science and technology to discuss the issues. Therefore, it is compulsory for Muslim scientist to make Halal database so-called H-Number database to facilitate food manufacturers. In this regard, the IQRAH (ID of Query Raw materials for Assuring Halalness) was developed by The Halal Science Center, Chulalongkorn University. At first, the Halal Science Center working together with the CICOT and Thai Halal industries and all the E-number used in the food industry in Thailand were listed. Then, the E-numbers which regularly utilized in Thai food industry were investigated for the Halal status by documentary evidence.

The E-numbers accredited by trusted Islamic organization were listed as Halal number (H-number) while remaining the number in accordance to E-number for example; E-400 to be H-400. The reason is to facilitate the manufacturer to access the H-number easily since most of the manufacturer is familiarize with the E-number. Some of the E-numbers without Halal certification were then required for investigating through the document review and interview the person in charge and were verified of Halal status by Halal forensic science laboratory testing. For E-numbers which were listed as Mashbooh were further discussed with CICOT, HSIT and Sheikhul Islam Office. Prior to publication of H-number ingredient list, the Halal ingredients derived from Trust Islamic Organization were again confirmed by the fatwa of Sheikhul Islam and Thai Islamic scholars with provision of scientific information from HSC's scientists. Similarly, Mashbooh ingredients and Haram ingredients were also verified by fatwa of Sheikhul Islam and Thai Islamic scholars. All the H-numbers also detailed with the name of raw materials producing company.

The Halal Science Center has been successfully published the H-number book namely "H Number: Halal Haram Mashbooh Ingredients List" by the cooperation of both Islamic scholars and Muslim scientists. This book is very useful for manufacturer to choose the Halal ingredient list of choices. This IQRAH is also one of Halal upstream management which is not only provide Halal ingredient list information but also elimination of other Halal processing cost which may burden the Halal food manufacturer compared to non-Halal food manufacturer. This is one of a great success of Muslim scientist to utilize the advancement of science and technology to accomplish the matter of religious concerns. The research and development of Halal replacement of Haram E-number is also an urgent needed to be seriously taken into action.

6 DIGITALIZATION

The certification and verification of the Halal product is more complicated. The Halal certification information is an important aspect in the traceability of Halal industry supply chain. Traceability is becoming a common element of public interventions and of private systems for monitoring compliance with quality, environmental, and other standards. Not only the information related to Halal products and services will be exchanged among organizations, but also the information within the organizations. The information is usually archived in electronic format within the responsible of each organization. However, most of the information could not be shared instantaneously because lacking of standard protocol to archive, format, and exchange them. This will be a crucial barrier for improving the competitiveness of Halal industry. In order to achieve this, the numerous of data from different sources are required to fulfil the requirement. The Halal Science Center has initiated System Protocol for Halal Electronic Resource Exchange, or SPHERE, to manage all data produced including Halal certification processes, HAL-Q system, IQRAH, Halal e-commerce, Halal tourist, Halal restaurant and so on, under SPHERE platform (Figure 5). Exchange of information of the Halal product will help investor/entrepreneur in national and international level for improving Halal social and business activity.

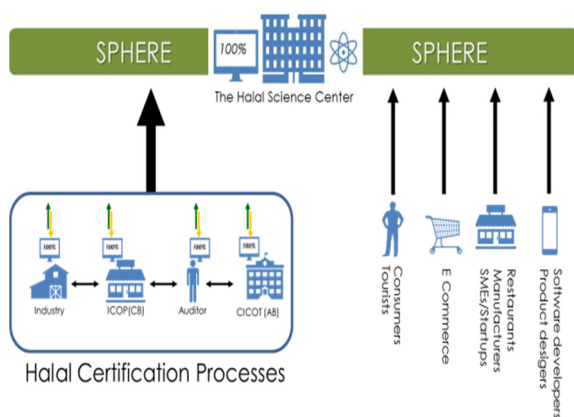


Figure 5: The concept of System Protocol for Halal Electronic Resource Exchange (SPHERE) initiated by The Halal Science Center, Chulalongkorn University in 2015.

7 CONCLUSION

Precision Halalization creates value-added of Thai Halal certified product which represent high product quality, security Halal assurance. By digitalization in all aspects of Halal value chain such as Halal certification, Halal forensic science laboratory, Halal management system, IQRAH, Halal processing could provide easy accessible of related data and high efficiency of facilitation with reducing time and cost consumption for the food manufacturers. This system will uplift the Halal certified products to be a major exporter of food in the world. Therefore, the precision Halalization is the system behinds Thailand Halal production for maintaining sustainable Thailand Diamond Halal and Halal for all.

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